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Report on an

Outbreak of Asiatic Cholera

In Shanghai during the summer of 1907

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By Stafford M. Cox, M.D.

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With a description of an improved method for the treatment
of cholera, by means of continuous transfusion,
of normal salt solution.

BY STAFFORD M. COX, M.D.

1908

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With a description of an improved method for the treatment of cholera, by means of continuous venous transfusion, of normal salt solution.

By Stafford M. Cox, M.D.

Early in August 1907, I was asked by Dr. Stanley, the Municipal Health Officer, to undertake the care and treatment of cholera patients admitted to the Municipal Isolation Hospital.

The outbreak had been in progress some little time. It was fortunately not a serious one, being confined to the poorer class of Chinese and to those of the foreign population, who neglected the precautions necessary in hot weather with regard to food, etc.

In Shanghai where the disease has been endemic, the first cases of cholera usually appear with the advent of the water melon and the general use of native ice. This approximates to a date at the end of June. The outbreak then usually reaches its maximum intensity during the month of August, gradually disappearing in September with the cooler weather.

Whilst I was in charge 159 cases of cholera were admitted: 16 foreigners and 143 Chinese. Of this number 103 were treated by continuous venous transfusion, the apparatus designed by R. H. Cox, F. R. C. S. I. being employed.

The normal salt solution used was made in the Municipal Laboratory, the usual formula being employed.

It was forwarded to the Hospital in sealed patent stoppered bottles, containing 2 pints.

In a certain proportion of the cases, a cholera antitoxin serum was added to the saline solution and transfused therewith.

The serum was manufactured in the Municipal Laboratory and was obtained from the blood serum of a horse immunised to cholera. As it had been made in 1906, more than 12 months previous to its use by me, its potency was open to question, and no deduction of value can be made from its employment.

The patients were brought in, in all stages of the disease. Transfusion however, was only applied in cases in which collapse was pronounced and death imminent.

Mild cases of the disease were treated by the use of the cholera serum hypodermically, saline rectal douches and acetozone drinks.

The diagnosis was verified in only a portion of the cases, owing to the pressure of work in the Laboratory, the Health Officer reporting "that from his examinations, he concluded the majority of the specimens were from cases of true Asiatic cholera."

A Bacterial Report confirming the diagnosis although desirable, was not essential, in that portion of the cases, in which transfusion was performed, for the reasons above stated, that it was only administered when the patient was in the stage of collapse and threatened by death.

Seventy-five per cent of the cases transfused had been under treatment by the Chinese barber surgeons, a procedure which would seem to militate against the success of transfusion later.

I had an opportunity of seeing one of these men performing the operation, at an earlier date during the same outbreak. It consists in acupuncture in various regions of the body. Plain bodkins are used of varying length, made of silver, with very sharp points. A rapid puncture is made into the quick of the thumbs, and blood squeezed out ; the veins in the fold of the forearm are separately pierced, the great toes, and the internal saphenous vein is then treated in a similar manner ; the tongue is hauled out and pierced through the root.

The longest bodkin is then inserted through the abdominal walls, in the middle line, below the ensiform cartilage, to a depth of 5 or 6 inches, and withdrawn, and the operation is completed.

It would seem that the verdict depends on the quantity and colour of the blood which escapes, and the response the patient makes to the stimulus. I noted that the spare bodkins were held between the teeth of the surgeon, when not in use. In this particular instance I had seen the man fall on the footpath as he walked and examined him, diagnosing Asiatic cholera. He expressed a wish to have the barber surgeon and one was speedily procured and having performed the operation, said that there was no hope. Before the ambulance arrived he was dead.

Well authenticated instances, in which this crude operation has proved of benefit are not lacking, and the writer suggests that the benefit may result from excitation of the sympathetic system, renewing the control of the capillary circulation, and inducing a condition perhaps sufficient for recovery in mild cases.

Whilst this unscientific procedure militates against the successful performance of transfusion later, its completion and the declaration of an unfavourable diagnosis by the barber surgeon, overcomes the scruples of the patient's friends with regard to removal to Hospital, and thereby the advantage of a contrast is given, between foreign and Chinese methods of treatment, in cases where the methods of the latter have failed to give relief and the patient is rapidly sinking.

The results following transfusion are little short of marvellous. I found that even if there was no indication of body temperature in the register scale of a thermometer, no pulse discernible, barely a heart sound audible if respiration however faint was still maintained, the case was by no means to be regarded as hopeless.

In at least 25 % of the Chinese cases transfused, it was a race between the establishment of transfusion, and the cessation of breathing.

In no other epidemic disease is the value of speedy measures so apparent, a few minutes being often the margin available for success.

Of the Chinese cases a great number of the patients had been found in the streets ; all possible according to Chinese methods having been done for the sufferers, they had been placed there to be found by the police. Probably in these instances, the sufferers were lodgers and the crippling expenses of a funeral for which the occupants might have to pay led to the procedure.

Extensive preparations for the reception of Chinese patients had been made by the Health Department, the services of two foreign lady nurses were given for the superintendance of the nursing, by the Chinese boys and amahs. No expense was spared, everything considered necessary for the treatment and comfort of the patients was promptly supplied ; such good results could not have been obtained were it not for these facilities.

The general ward for Chinese, was a long room, with south and north aspects, containing 30 beds. At one end of this room the apparati were placed in such a position as to be available, without being moved for a bed on either side. These beds were kept empty, ready for the reception of transfusion patients, with hot water bottles and blankets.

If collapsed and pulseless the patient was placed on one of these beds, if able to swallow some camphor and brandy administered, and hand rubbing to the abdomen and body was maintained by assistants, whilst preparations for transfusion were made by another.

The temperature of the saline registering 116°, the heat regulating apparatus being satisfactorily adjusted and the tube having been searched for bubbles of air, the patient's arm was washed with an antiseptic, a bandage was applied around the upper arm close to the armpit controlling the superficial veins. A choice of veins was then made, the determining factors being size, straightness, and the presence or absence of marks showing previous tampering by the barber surgeons.

The writer for various reasons, seldom used one of the veins in the fold of the elbow, median basilic and median cephalic. They were generally found pierced by the barber surgeons, were sometimes found too large to maintain a grip on the canula and their oblique direction to the main stream often led to the canula impinging against the wall of the intercommunicating vein, thereby stopping the flow of saline.

Moreover, it was considered that if any one of them had been punctured, the flow of saline, through the intercommunicating channels might disengage a clot into the main stream.

The usual vein selected was the cephalic which is free from any of these disadvantages, the point selected being in its path over the convex biceps muscle. The vein being apparent, the skin overlying was lightly drawn aside, with two finger tips held slightly apart. An incision 1½ inches long was then made down to the sheath, the skin allowed to fall back, the vein thoroughly cleared of its adhesions to its sheath, a needle canula passed underneath and the vein tied at the lower end of the incision. A transverse snip was then made extending half way through the calibre of the vein, the vein emptied of blood from the bandage to the wound, and the canula inserted; the bandage round the limb was then removed, a strip of plaster applied retaining the canula in position and a piece of Iodoform gauze placed over the wound.

The operation was performed on every occasion without employing any local sedative, pain was seldom complained of, the patient's collapsed condition accounting for the absence of sensation. The arm was then bound to a splint and fastened to the edge of the bed. Sometimes it was found necessary to secure the other arm to the bed, owing to the violent motions caused by colic and loss of blood.

In ten or fifteen minutes if everything is going well, a pulse is perceptible at the wrist, the patient is able to take a drink, vomiting passes off, the ashy tinting of the skin changes to a more lifelike colour, the lines and creases of agony in the face fade away, the body becomes perceptibly warmer, abdominal colic ceases, and the patient perhaps sleeps the sleep of exhaustion.

The body temperature steadily rises, and within an hour is one or two degrees above normal. At this stage a rigor of varying severity invariably sets in, the patient complains of cold, cramp of the abdominal muscles, and the muscles of the thigh. This train of symptoms seldom lasts longer than ten to fifteen minutes and relief is found in warmth, rubbing, and perhaps some camphor and brandy.

Transfusion is maintained as a rule for four or five hours, till the drain on the circulatory system has been made good.

Directly an equilibrium of pressure between the venous circulation and the apparatus is established, the fluid in the glass canula is noticed to be tinged with blood, and if the canula is not removed, a clot is formed and the flow of saline ceases.

At this stage the canula was usually removed, the vein tied in the upper extremity of the wound and a dressing applied.

No ill results followed in the instances in which the canula was left in position for 12 hours or more, but on the other hand no benefit could result after equilibrium was established and a clot formed. In some instances because of high fever setting in, or the apparatus being urgently needed, the canula was removed before the period of stasis.

In view of the opinion held by some medical men, that transfusion is responsible for the thrombosis and embolism seen in the later stages of cholera, the following case is of interest.

Woman, age 31, when admitted, was in a semi-unconscious state, took beef juice and brandy with difficulty, heart's action strong, pulse full and regular, 50 beats to the minute, temperature 97°; later, the patient cannot be roused, temperature 98°, complete unconsciousness; the condition was attributed to thrombosis of the basal sinuses; the patient died 12 hours after admission.

As this case was not transfused, and yet presented a perfect picture of the later stages of cholera, where thrombosis is present, it is evidently a mistake to attribute this condition in all cases, as due to transfusion.

Of the 28% of fatalities in transfusion cases 15% was considered due to clotting of the cerebral sinusis with accompanying meningitis. For the most part these circulatory lesions were found in well nourished patients of good physique. At first perhaps two or three days after admission, the patient would be reported as having been restless, moaning in his sleep, as being disinclined for food, drowsy; afterwards the patient's mental perceptions become perceptibly blunted, his speech becomes incoherent, often a great difficulty is found in keeping him in bed. When he does get up, he at once tumbles, being apparently unable to preserve his equilibrium. Very little if any fever is present, the pulse is strong, slower than normal, and beyond his mental condition there are no grave signs of sickness. He talks incessantly when awake, moans when asleep, cries like a wounded animal if disturbed, either devours his food with his fingers or does not seem to know what to do with it. Familiar objects or their uses are not recognised and the patient resents interference.

Some of these cases afterwards considerably improved and went out under the care of their relatives, but the great majority went from bad to worse, refusing food, and gradually sinking into complete unconsciousness and death. Of other circulatory lesions, the cause of death in one case was pulmonary infarction.

In urgent cases of cholera where collapse is marked, as the margin of time available is small, every precaution should be taken to eliminate the possibility of mechanical obstruction to the flow of saline.

The obstruction may be due to faults in the apparatus such as deposits of salt crystals on the filter core for which scrubbing and sterilizing usually suffices to kinking of the tubing, obviated by applying restraining strips of plaster in the course of the tube towards the limb.

With a difference in level of three feet, between the apparatus and the patient's body, the canula should give a stream of the height of 6 to 8 inches.

After each transfusion, the tubing and canula should be cleaned, tested for permeability and placed in a 1-80 carbolic solution until required. The filter core scrubbed and cleaned once daily.

Obstructions to the flow within the body itself will be exceedingly rare, if the straight vein already described is utilized.

With regard to the amount of saline transfused, it was found that if stasis occurred in the flow before 8 to 10 pints was absorbed, the improvement was seldom of lasting benefit, and on the other hand, where this or a larger amount was absorbed, a proportionately more favourable prognois might be given.

In this connection it is interesting to consider whether the proportion in the benefits resulting can be attributed to the remedial effects of saline on the infected tissues in proportionate doses or more reasonably that complete collapse, be regarded as the best evidence of an uncomplicated case; attributing the *partial or complete* absence of collapse found in a proportion of grave cases of cholera as evidence of the presence in a varying degree of a superadded inflammatory condition sufficient in itself to combat the manifestation of collapse.

No post-mortem examinations were allowed.

TABLE I.

Number of cases of cholera admitted to the General Hospital Shanghai, during each year of outbreak from 1881 to 1907 inclusive, with the average mortality in cases treated.

Year	No. of Cases	Re-covered	Died	Mortality
1881	26	14	12	46 per cent
1882	25	13	12	48 ,, ,,
1883	28	8	20	71 ,, ,,
1885	39	16	23	59 ,, ,,
1886	25	8	17	68 ,, ,,
1887	26	8	18	69 ,, ,,
1888	7	1	6	86 ,, ,,
1890	26	9	17	65 ,, ,,
1891	39	18	21	54 ,, ,,
1895	24	10	14	58 ,, ,,
1896	21	12	9	43 ,, ,,
1902	73	40	33	45 ,, ,,
1903	39	24	15	38 ,, ,,
1907	10	4	6	60 ,, ,,
Totals	408	185	223	54.9 ,, ,,

TABLE II.

Number of cases of cholera admitted to the Municipal Isolation Hospital Shanghai, during the two years in which it was open, with the average mortality in cases treated.

Year	No. of Cases	Re-covered	Died	Mortality
1903	13	5	8	61.5 per cent
1907	197	126	71	36. ,, ,,
Totals	210	131	79	37.6 ,, ,,

TABLE III.

Number of cases of cholera amongst Chinese admitted to the Isolation Hospital, during my period of charge with the mortality amongst those treated by continuous transfusion, and those treated by ordinary medical procedure.

	No. of Cases	Re-covered	Died	Mortality
Trans-fused	89	64	25	28 per cent
Non-trans-fused	54	37	17	31.5 ,, ,,
Totals	143	101	42	29.2 ,, ,,

This table does not give full justice to the merits of the saline transfusion treatment. The two sets of cases were not of equal gravity; collapsed cases being chosen for transfusion whilst the others were expected to recover without its aid.

TABLE IV.

1907. Isolation Hospital, number of cases amongst Chinese treated by the continuous transfusion of normal salt solution, and the mortality with the number of cases treated with cholera serum, added to the normal salt solution and the mortality.

	No. of Cases	Re-covered	Died	Mortality
Normal Salt Solution	65	48	17	26 per cent
With added Serum	24	16	8	33.3 ,, ,,
Totals	89	64	25	28 ,, ,,

No deduction of value can be drawn from the foregoing table with regard to the merits of the two methods employed, as the cholera serum used was more than 12 months old.

The increased mortality in the cases in which the serum was used is possibly owing to its use being limited to the earlier and probably more virulent cases. No ill effects were noticed as following its use.

TABLE V.

1907. Isolation Hospital. Racial mortality.

Nationality	No. of Cases	Recovered	Died	Mortality
British	2	2	. . .	. . . .
Japanese	10	3	7	70 %
Indians	3	3	. . .	. . . .
Chinese	143	101	42	29.2 %
Assamese	1	1	. . .	. . . .

All 7 deaths amongst the foreigners treated were Japanese.

Considering that the same means were employed in the treatment of all alike, the difference in the percentage mortality of the Japanese treated and the other races seems extraordinary.

In physique they compared favourably with the other cases of different races; they were all treated in second class wards, particularly bright, cheerful rooms, with every facility for nursing at hand, and they had trained European nurses in attendance day and night; the conditions seemed favourable for treatment in every respect. A marked difference in the attitude of mind displayed during their sickness, was however apparent.

Amongst the cases of other races, in consequence of the relief they had found from agonising pain and collapse, in transfusion; complete reliance on the ability of their attendants to adequately treat them further were it necessary, was the general rule; and thus a tranquil condition of mind followed, highly beneficial in aiding recovery.

This was especially noticeable amongst the Chinese; better patients than they proved one could not wish for; they quickly adapted themselves to their foreign surroundings and cheerfully acquiesced in the necessary restrictions placed on food and drinks.

The Japanese patients on the other hand, seemed to fail in adapting themselves to their surroundings, fretted at the necessary restrictions on diet, were ever in need of something and dreaded being left alone; beyond this dissimilarity in temperament, no other distinctions likely to influence the course of treatment were noted.

TABLE VI.

1907. Isolation Hospital, number of cases amongst foreigners admitted under my care, with the mortality amongst those treated by transfusion and those treated by ordinary medical procedure.

	No. of Cases	Recovered		Mortality
Transfused	14	8	6	43 per cent
Non-transfused	2	1	1	50 ,, ,,
Totals	16	9	7	43·75 ,, ,,

Isolation Hospital, 1907. Particulars of treatment of

NATIONALITY	AGE	CONDITION BEFORE TRANSFUSION	DATE	TIME
1 Assamese	28	Collapsed, temp. 97°, colic, purging and vomiting. Rice water stools.	17 Aug.	10.45 a.m.
2 British	30	Very collapsed, husky voice, severe colic, purging and vomiting.	11 ,, 12 ,, 13 ,,	6 p.m. 8 p.m. 4 p.m.
3 British	40	Collapsed 96.6, diarrhoea and vomiting, marked prostration.	9 ,,	11 a.m.
4 Indian	27	Marked collapse, apparently moribund. Temp. 96.8, incessant purging.	19 ,,	10 a.m.
5 Indian	40	Temp. 97.2, very weak and collapsed. Again collapsed.	27 ,, 2 Sept.	4.30 p.m. 9 p.m.
6 Indian	30	No temp. or pulse, moribund.	18 Aug.	9 a.m.
7 Japanese	22	No collapse, not transfused.	———	
8 ,,	25	Mild case ,,	———	
9 ,,	30	Collapse marked, no pulse at wrist.	15 Aug.	12 p.m.
10 ,,	23	Collaspe, incessant vomiting and purging. No pulse, no temperature.	27 ,, 1 Sept.	10 p.m. 10 a.m.
11 ,,	48	No pulse, no temp., very collapsed.	27 Aug.	9.30 p.m.
12 ,,	24	Temp. 96.4, marked collapse, no pulse.	27 ,,	9 a.m.
13 ,,	29	No temp. no pulse, moribund.	10 Sept.	8 a.m.
14 ,,	23	Temp. 97, collapse, no pulse.	26 Aug.	9 a.m.
15 ,,	22	On admission temp. 99.° pulse 104. Following day marked collapse, no pulse or temperature, moribund.	1st day 29 August 30 Aug. ,, 1 Sept.	 8 a.m. 12 a.m.
16 ,,	28	On admission no pulse or temp., extreme collapse.	29 Aug.	3 p.m.

Foreign Cholera Patients, during my period of charge.

QUANTITY	CONDITION AFTER TRANSFUSION	RESULT	REMARKS
θ vii with serum	Temperature 102.6, at 12 o'clock 99°, immediate relief.	Recovery	On the 20th inst. left Hospital, cured.
θ xi with serum	Great relief from all urgent symptons		
θ xvii	Transfusion allowed to run all night, much better.		Collapse again set in.
θ vi under skin injection		,,	Uninterrupted convalescence.
θ x with serum	Temp. 100.4, improvement, stools still frequent but no collapse.	,,	Had typhoid, small-pox and cholera in sequence.
θ xp with serum	Temp. 106.4, at 8 p.m. 100,° marked improvement.	,,	No relapse, left Hospital on the 25th.
θ vi ,,	Temp. 102.8, general improvement.	,,	
θ xp	Temp. 100.° No bad signs.		Discharged on the 9th Sept., convalescent.
θ xp with serum	Temp. 103.° pulse 120, general rally.	,,	No further transfusion.
——	————	Died	Dysentenic form.
——	————	Recovery	Saline douches.
θ xiii with serum	Temp. 103.° pulse 132, general rally.	,,	Discharged 21, cured.
θ ix ,,	Temp. 104.° marked improvement.	Death	Required incessant attention, mental sympton.
θ viii	,, 102.° no general improvement.		
θ xii with serum	,, 103.° pulse 90.	Death	,, ,, ,, Mother of previous case.
θ viii with serum	Temp. 105.8 pulse 130, no bad signs and no further collapse.	Recovery	Discharged on 30th, convalescent.
θ xi with serum	Temp. 101.2 pulse 124, great relief.	Death on 6th day	Meningeal symptons.
θ ix with serum	Temp. 104.6 pulse 116, improvement, no further collapse.	Death on 3rd day	Death attributed to cardiac thrombas.
θ vi with serum	Improved clotting in canula.	Death on 4th day	The persistency of the collapse was very marked.
θ xvi	Temporary improvement, purging		
θ xiii	No reaction, passing stools in bed.		
θ xii	Temp. 103.6 seems much improved.	Death	Cardiac failure.

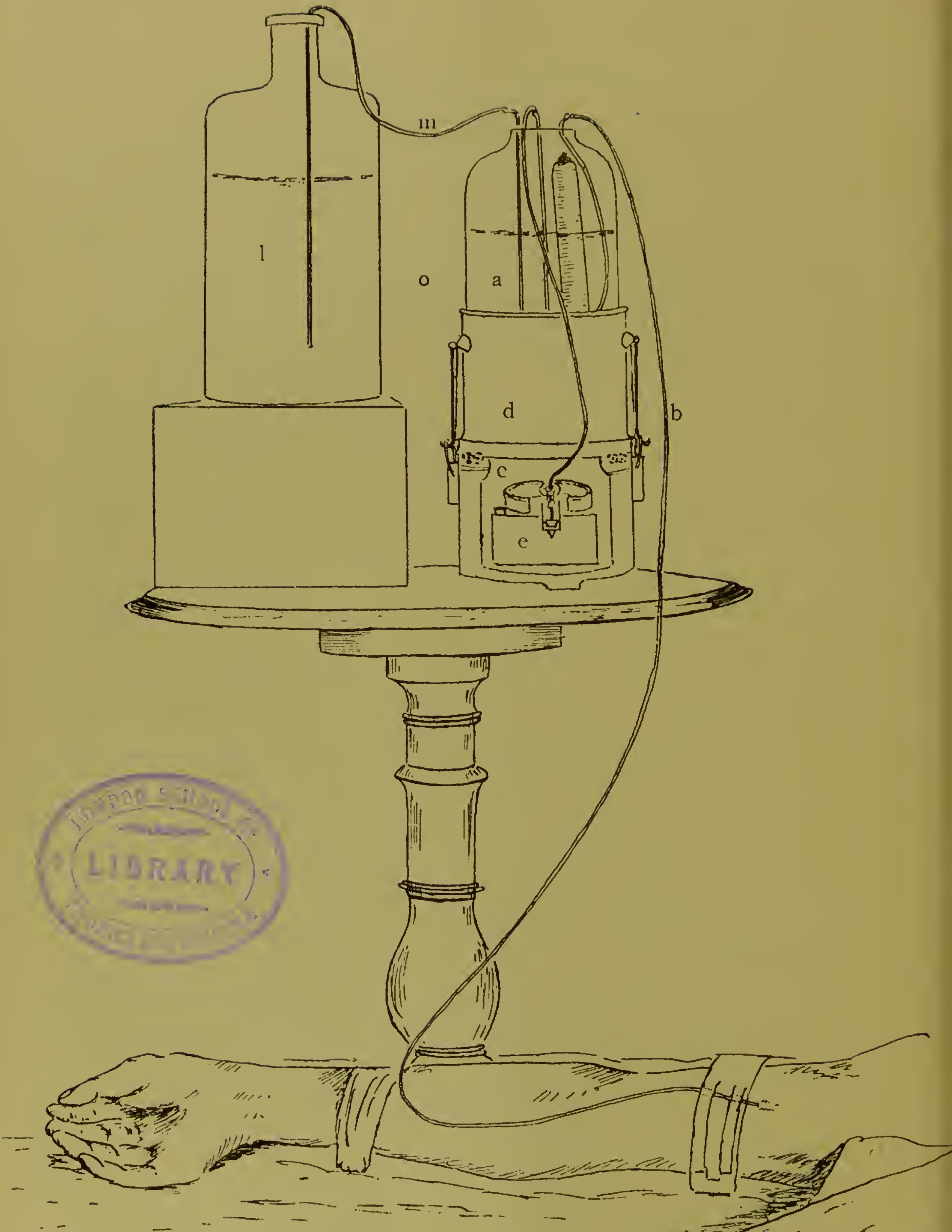

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TABLE VII.

1907. Isolation Hospital. Number of cases admitted under my charge in their decennial age periods with the mortality for each.

Age	No. of Cases	Re-covered	Died	Mortality
1 to 10	3	2	1	33⅓ per cent
11 to 20	20	16	4	20 ,, ,,
21 to 30	74	52	22	29 ,, ,,
31 to 40	41	25	16	39 ,, ,,
41 to 50	16	11	5	31 ,, ,,
51 to 60	5	4	1	20 ,, ,,
Totals	159	110	49	30.8 ,, ,,

Here it is seen that nearly 75% of those attacked, were between 20 and 40 years of age, and that the mortality was greatest between the ages of 31 and 40.

TABLE VIII.

1907. Isolation Hospital. Day of disease on which the deaths occurred. Transfused and non-transfused cases.

Day of Disease	1	2	3	4	5	6	7	8	9	10	11
Non-Transfused	10	1	1	1	.	2	1	.	.	.	1
Transfused	6	5	2	6	2	.	1	1	1	1	.

It may be seen that 63% of the mortality in non-transfused cases occurred on or before the second day and that 44% of the mortality in transfused cases occurred on or before the second day.

Transfusion will at least postpone if it does not avert a fatal issue.

DESCRIPTION OF APPARATUS AND DIRECTIONS FOR USE.

The apparatus consists of the following parts as shewn in Fig. 1 :—

1. (*a*) A glass cistern.
2. (*b*) A metal stand, consisting of two compartments (*c*) a chamber for the spirit lamp and (*d*) water bath for the cistern.
3. A heat mechanism with regulator attachment consisting of (*e*) a spirit lamp, with glass shade.
4. (*f*) A glass air chamber for submersion in the saline fluid in the cistern.
5. (*g*) A balance mechanism having a collar, surrounding the wick of the lamp at one end of the beam, and a small bucket, containing a 25% glycerine and water solution at the other end. This beam is supported on a frame having a hole at either end, into one of which is fitted the neck of the lamp, whilst a clip in the middle holds a bent glass tube, containing glycerine solution, and so placed that one drawn out end dips into the glycerine solution in the bucket, whilst the other is connected by a fine rubber tubing with the air chamber.

(*h*) A floating mercurial thermometer.

(*i*) A Berkfeld filter core, with short thick rubber tubing attaching its nozzle to a glass tube with bent free end. The filter core is placed in the cistern, in an inverted position, the bent end of the glass tube appearing over the edge of the resevoir. (*j*) A long rubber delivery tube (2½ yds) for attachment to the bent end of glass tube above described, having inserted in the first third of its length a glass current indicator, (*k*) a glass canula for insertion into the vein is joined to the end of the long delivery rubber tube. (*l*) A resevoir. (*m*) A resevoir feed tube consisting of two glass tubes joined by rubber tubing, establishing a communication between the cistern and the resevoir.

Three bottles containing spirit, glycerine and saline powder. A roller clamp for establishing syphon action. A salinometer adjusted for boiling point. A wooden case with directions for use.

Fit the parts together as shewn in the accompanying drawing which gives a side view of the balance mechanism for clearness. Put a few ounces of hot water in the water bath, fill the lamp with spirit and the little pocket with glycerine solution. Trim the wick of the lamp, so that it projects only ⅛ th. inch beyond the collar when it is down, make sure that no part of the wick touches the collar or it will interfere with its freedom of movement. Detach the small rubber tubing at its connection with the air chamber, light the lamp and test the balance regulator for ease of movement and its control on the size of the lamp flame. This is best done by gently blowing and sucking through the rubber tubing. If the balance turns with about a drop of glycerine solution and the flame at its lowest is only a point of blue light, (*i.e.*, less then sufficient to maintain the saline in the cistern at 116° F.) and the balance at rest, is in a state of equipoise, the correct adjustment will be found to be made.

Preparation of Saline Solution: To prepare the saline solution, fill a kettle or other suitable vessel with boiling water, place on a fire and put the boiling point salinometer into the water, stir in sufficient to make the salinometer appear on the surface, take off the fire and if the salinometer floats add boiling water ; if it sinks stir in salt till the salinometer is balanced in the fluid. Place the kettle and its contents in a basin of cold water cooling the saline till it is 116°, then nearly fill the cistern with the solution, hang the filter core with its thick rubber tube and glass tube firmly tied to the nozzle, on the side of the cistern. Examine the temperature of the solution, leaving the thermometer floating in the fluid. If the temperature registers 116°, connect up the heat regulating mechanism by joining the small rubber tube to the air chamber.

Connect the long rubber tubing with its current indicator and canula already adjusted, to the bent tube leading from the filter core.

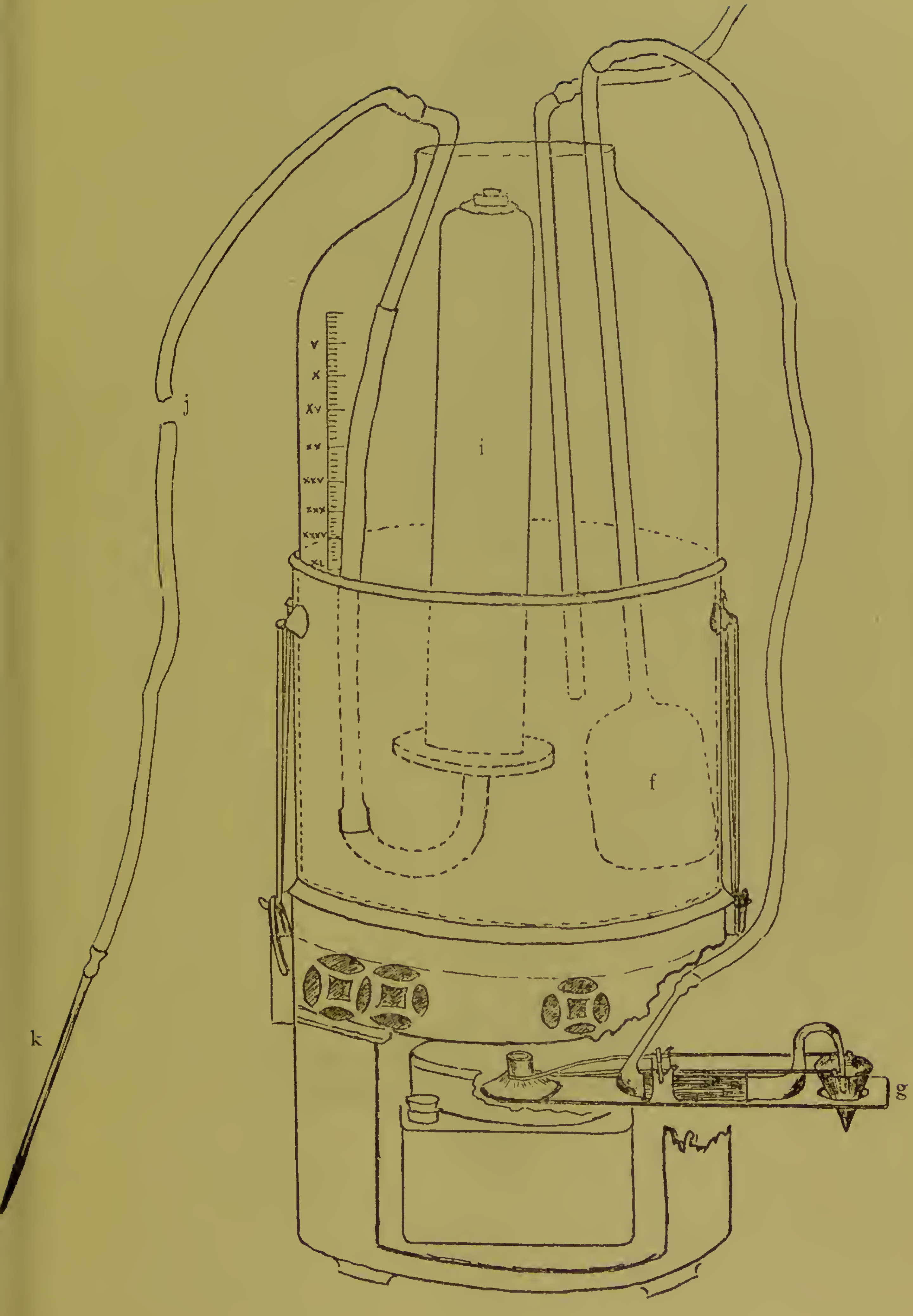
Establish syphon action in the filter by milking the rubber tube with the roller clamp, and then invert the filter.

The air bubbles are got rid of by passing a finger along under the long rubber tube and raising it in successive lengths till the canula is reached, the dependent canula should then be turned vertically upwards to allow the last of the bubbles to escape, and the apparatus is ready for use.

The current indicator should be connected with the weighted end of the glass float towards the canula ; hanging vertically its action is more sensitive.

The different connections in the long feed tube should be secured with soft cotton string or fine tape. The presence or absence of flow can be ascertained by inspection of the current indicator, as well as by the degree of warmth of the feed tube. The force of flow is regulated by the difference of levels measuring from the surface of the fluid in the cistern to the vein. It should be fixed at between 2 to 3 feet. With such an adjustment should the force of flow be insufficient to throw a jet 6 to 8 inches high the filter should be removed and scrubbed and washed out as the loss of power is probably owing to the crystallization of salt on the filter core.

The temperature of the saline in the cistern is maintained at the degree set by the heat regulator, the action of which is as follows : When the tem-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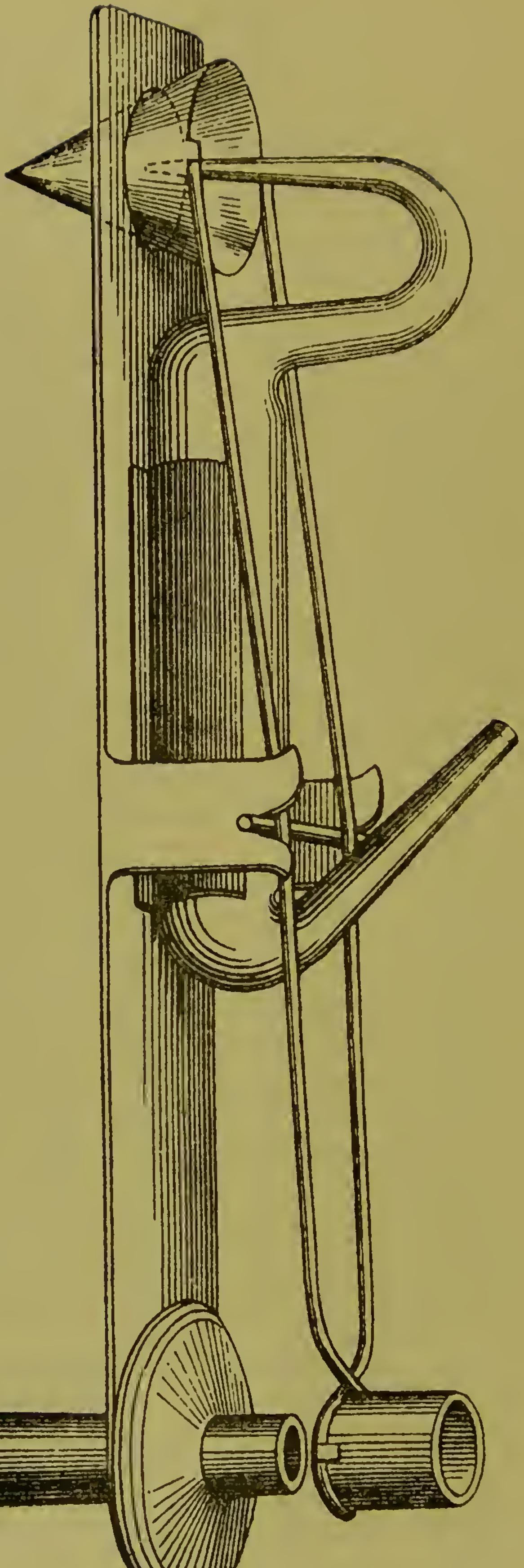

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perature of the fluid is 116° F. the rubber connection having been made at this degree, with the beam of the balance in equilibrium, the air contained in the glass air chamber exercises no action on the glycerine solution contained in the bent glass tube ; if owing to a diminished thirst in the veins, a retarded flow, or a flaring of the lamp, the temperature of the fluid in the cistern is raised to above 116° F. the air in the submerged air chamber expands, and forces some of the glycerine solution from the bent tube into the bucket of the balance, thereby depressing that end of the beam and consequently raising the other with its collar fitting round the flame, the result of which is to lessen the burning surface of the wick to such an extent that the heat communicated to the fluid in the cistern is less than sufficient to maintain a temperature of 116° F. at which it was set.

Should an opposite condition of things be set up, as by an increased thirst in the veins and the fluid in the cistern fall below 116° F., the air in the air chamber contracts, drawing some of the glycerine solution from the bucket into the bent tube, thus causing that end of the balance to rise and the other with its collar to fall, exposing an increased surface of burning wick, and causing a consequent rise of temperature.

The extent of the surface of burning wick exposed is thus automatically controlled by the contraction and expansion of the air, in the air chamber and the temperature of the saline maintained at the height for which the mechanism is set.

116° Farenheit is the degree of heat which has been found most suitable at which to adjust the regulator ; allowing for radiation, the saline will probably be admitted at 102° to 104° Farenheit.

The sensitivity of the air chamber depends on its size. With a capacity of 2 fluid ounces, a control is given with a range of not more than 1° Farenheit from the point at which it is set.

New filters should be carefully washed out before being used, to obviate the possibility of solid particles from their interior being carried into the circulation. This is best done by using a Birkefeld travelling pump with water at 120° Farenheit. The empty filter is readily filled by submerging it, hung by its hooked end, over the side of the cistern.

During transfusion it is not necessary to have the filter candle entirely covered with fluid as the flow will continue as long as any portion of the filtering surface is submerged and will cease, without carrying air.

It should be remembered however, that equality of temperature is best maintained with a fairly full cistern.

The utility of a filter core may be tested by submerging it in water and blowing through its tube. Should bubbles of air appear the filter is useless.

Notes Concerning the use of the Cholera Transfusion Appartaus During September 1908.

A modification adopted this year, with satisfactory results, was the fixation of a thermometer in the course of the delivery tube at a point close to the canula. The loss of heat by radiation from the saline in the delivery tube in its path to the body varies with each case. It is influenced by the temperature of its surroundings, the length of the tube, and the rapidity of the current. If the elevation of the cistern is the same for each case the rapidity of the current is then dependant on the thirst of the veins (*i.e.*, the degree of collapse). The adoption of this procedure enables consistency to be maintained in the degree of temperature of the saline at its ingress to the body, by raising or lowering the temperature of the saline in the cistern. Difficulty arises only where two cases with unequal requirements are being transfused from the same cistern. The difference is never very great, and the application of cold or heat to the tube requiring it can be given by passing the tube through a dish of cold or hot water. The ideal condition, however, is an apparatus for each person transfused.

A large percentage of the 'barber surgeon cases' were transfused in the jugular vein which the barber surgeon never seems to tamper with.

Urotropine gr. 1½ to one fluid ounce, with Tincture of Orange as flavouring, is the only thing given for three days, the writer having come to the conclusion that it is absolutely useless giving food of any kind whilst the stomach and bowels are so disorganised.

Every day the inside of the filter cores were washed out with water at 120° to get rid of detritus, by means of a Berkfeld travelling pump.

A more detailed observation of the cases was possible owing to the valuable assistance of five Chinese doctors, Drs. Dzo, Woo, Tong, Zee and Chang with the result that each case received that separate attention which its degree of collapse required. In each case the two conditions of collapse which it was considered essential should be amply met, were firstly, the loss of blood fluid, and secondly, the loss of surface temperature. Transfusion of saline was continued as long as it was shown to be well borne, that is to say until cardiac distress was evident; the shrinking of the finger pulps, the hollowness of the cheeks and the sunken condition of the eyes disappear much earlier. It was noticed that when cardiac distress was evident a watery discharge from the bowel relieved it considerably and was no doubt productive of good results in flushing the bowel and intestines. If this condition was established transfusion might be continued as the circulation continues to relieve itself in this vicarious manner with good results to the patient. The second condition of collapse, the absence of temperature, is regarded by the writer as the most productive of evil consequences. It seems to deprive the body of all its powers of resistance to the disease, consequently the rule observed has been to continue transfusion until a temperature of 103° to 104° is obtained. Should it be found that the body need of fluid had been fully met without an elevation of temperature to this extent, on removal of the canula the patient was wrapped in blankets and hot-water bottles applied. In second transfusions it was found that the kidney elimination restored by the first transfusion was retarded by the second, but this condition seldom lasted more than twelve hours. The necessity of complete abstinence from food for three complete days was repeatedly demonstrated. Secondary transfusions were necessary in four cases in which Valentine's Beef Juice had been given two days after transfusion. I have not seen a case in the outbreak of last year, or this, in which this abstinence has produced injurious consequences. It would seem as if food given earlier served as a medium in the stomach for the propagation of the bacillus or its ptomaines.

The food which was found to answer best, as a beginning, was an egg beaten up with hot water, or diluted milk.

Out of nineteen sent from a Chinese cruiser, four days since, three died ; two of these died on the way to the hospital, and two died subsequent to transfusion ; the remaining fifteen are still alive, nine of them required second transfusion.

The results for this year, work out approximately at 174 cases transfused and 28 deaths ; a mortality of a little more than 17%.

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Brief Account of the Work done during 1909.

The scope of the work was this year considerably extended, this was in part owing to the increased number of medical men, rendering voluntary assistance, and in part to the valuable services rendered by His Excellency Shen Tun Ho.

The Doctors assisting were, my partner Dr. Hans Thue, Woo, Forrest, Qee and Dzo, and to them, the Committee tender their grateful thanks.

The provision of adequate medical assistance, however important, is of little use, without the facilities for its employment.

In this respect, no expense was spared by the Committees of both Hospitals, and all our requirements were promptly met.

Our thanks are due to their Excellencies Shen Tun Ho, Chu Pau San, Yen Tze Chun, Doctor Wang Siao Tang, and numerous other Chinese gentry for their generous support and practical help.

Our thanks are also due to Messrs Burroughs and Wellcome, and the Shanghai Dispensary for the supply of drugs, and appliances, at a specially reduced rate.

The previous Reports for 1907 and 1908 gave sufficient particulars of the mode of treatment; for the present year, the following Table, briefly supplies details of the number of cases treated, and the percentage of mortality.

The total number of cases was just over 3,000; of this number 666 cases were of so grave a character as to require Transfusion.

TRANSFUSED CASES.

Age.	Number of Cases.	Cured.	Died.	Returned Home.	
1-10	39	28=71.8 %	9	2	28.2 %
11-20	126	112=88.9 %	12	2	11.1 %
21-30	192	166=86.5 %	25	1	13.5 %
31-40	171	138=80.7 %	31	2	19.3 %
41-50	105	74=70.5 %	27	4	29.5 %
51-60	28	19=67.9 %	6	3	32.1 %
61-70	4	3=75 %	1	0	25. %
71-80	1	1=100 %			
Totals	666	541=81.2 %	111	14	18.8 %

The cases shown under the heading Returned Home, were for the most part, unbenefitted by Transfusion and as difficulty was found in ascertaining the subsequent history, it is though best to show them all under the heading of fatal cases.

S. M. Cox, M. D.

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